

PRODUCT CODE: DEC-8E-XBINA-A-D  
PRODUCT NAME: Self-Starting Binary Loader  
User's Manual  
  
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## SELF-STARTING BINARY LOADER (SS BIN)

### 1.1 ABSTRACT

The Self-Starting Binary Loader (SS BIN) reads and stores 12-bit data words from binary format papertape from either the low speed reader or the high speed reader. If a starting address is supplied the program will be started at the completion of loading.

### 2.1 EQUIPMENT

The SS BIN requires a PDP-8/E or PDP-8/M with either a low speed papertape reader or a PC8-E high speed reader. It may be used with MI8-E Bootstrap (RIM) Loader.

### 3.1 MEMORY REQUIREMENTS

The SS BIN occupies locations 7600-7755 and location 7777 of one memory field. It may reside in any memory field, as long as the RIM loader is in locations 7756-7776 of the same field. Use of the data break facility, which affects locations 7746-7755 of field 0, will not affect SS BIN. Data may be loaded into fields 0-7.

### 4.1 OPERATING INSTRUCTIONS

SS BIN is loaded with the RIM loader as the first part of a two part tape. The format of these tapes is described in the section on papertape format. The second part, separated from SS BIN by leader/trailer, is the object program or data to be loaded. Instructions are given below for use without a switch register and with the MI8-E, and for use with a switch register and without the MI8-E. If the object program is not attached to SS BIN or if there is more than one object tape, see the section on special conditions later in this document.



#### 4.1.1 With the MI8-E Bootstrap Loader

1. Place the initial leader/trailer of SS BIN over the read head of the selected reader. If the low speed reader is to be used, turn the main switch to ON-LINE and the reader control to START. If the high speed reader is to be used, set its control to ON-LINE.
2. Activate the SW switch, located on the lower left of the front panel, by moving it from the down to the up position. This will load and start the RIM loader. It will load SS BIN, which will start itself, load the object program and start the program. (If no switch register is present, it is essential that the object program specify a starting address).

#### 4.1.2 With the Switch Register

1. Be certain that the RIM loader for the appropriate reader is in memory. This procedure is described in Introduction to Programming, Appendix E1.
2. Place the initial leader/trailer of SS BIN under the read head of the selected reader. If the low speed reader is to be used, turn the main switch to ON-LINE and the reader control to START. If the high speed reader is to be used, set its control to ON-LINE.
3. Set the instruction field and data field to the field of the RIM loader. This is done by multiplying the field number by 11, setting the result on the switch register, and pressing EXTD ADDR LOAD.
4. Set the switch register to 7756, which is the starting address of the RIM loader.
5. Press ADDR LOAD, CLEAR, and CONTINUE. This will start the RIM loader. It will load SS BIN, which will start itself and load the object program. If a starting address was specified, the program will be started. If no starting address was specified, SS BIN will halt at the beginning of the final leader/trailer with the accumulator (AC) set to 0.



#### 4.1.3 Checksum Errors

At the end of each binary tape is a two frame code called the checksum. Its calculation is explained in the section on papertape format.

It is used to determine if the same holes were read by SS BIN as were punched in the tape. It was calculated once when the tape was punched and again as it is being loaded by SS BIN. The two totals must agree. If they do not, an error has been made and SS BIN halts with the AC equal to the difference in the calculations. If a starting address was specified, the program is not started. The tape should be reloaded, beginning at step 1 of the appropriate procedure. If SS BIN halts again with the AC equal to the same number as in the previous load, the fault is probably with the tape. If SS BIN halts with the AC equal to a different non-zero number, the fault is probably with the reader. If the AC is 0 or if the program starts, the load was good.

#### 4.1.4 Special Conditions

If there is a switch register and there are additional tapes to be loaded, they may be loaded after the loader has halted with the AC equal to 0, as in step 5 above. Place a tape in the reader and press CONTINUE. If the load was good SS BIN will again halt with the AC equal to 0. If a starting address is specified, it must be on the last tape loaded. If no switch register is present, additional tapes, if preceded by SS BIN, may be loaded with the MI8-E in the same manner as the first tape.

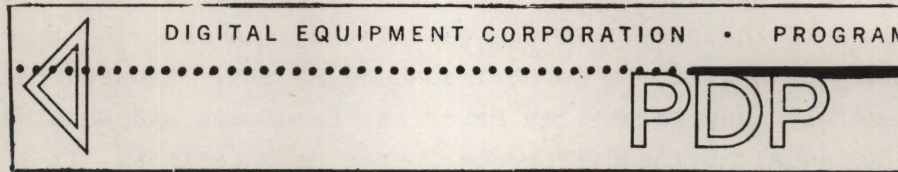
SS BIN will remain in memory unless locations 7600-7745 are used for another purpose. If a switch register is present, tapes without SS BIN attached may be loaded later by placing them in the reader and starting at 7777.

If SS BIN is not attached to the object tape, the following procedure may be followed:

1. Examine the SS BIN tape. Carefully remove any tape after the final leader/trailer which contains characters other than leader/trailer or blank tape. Be sure the end of the tape is torn smoothly and squarely. With scissors remove the last inch of sprocket holes,



as in the example which follows. Do not cut into any of the 8 information channels of the tape. This is to prevent extraneous characters from being read from the end of the tape.



2. Load SS BIN alone according to the procedure described for a normal load. When the tape has run out of the reader, the reader will halt, but the computer will not (the RUN light will be on).
3. If the Teletype reader is being used, set the switch to STOP; if the high speed reader is being used, set the switch to OFF-LINE.
4. Remove the SS BIN tape and insert the object program tape with leader/trailer or blank tape under the read head. Set the reader switch to START if the Teletype is used or ON-LINE if the high speed reader is used. The tape will be loaded in the usual way. If the SS BIN tape has not been trimmed, it may still be used, but the reader must be turned off as in step 3 before the end of the tape is reached.

#### 5.1 PAPERTAPE FORMAT

RIM and SS BIN expect the papertapes to be in the following format:

1. Leader/trailer (ASCII code 200).
2. Self-starting Binary loader in RIM format.
3. Checksum of SS BIN or two frames of leader/trailer.
4. Leader/trailer or blank tape.
5. Program to be loaded, beginning with an origin setting. If it is to be loaded into a field other than the field of the loaders, it must also begin with a field setting.
6. An origin setting at the end of the program, if it is to be started by SS BIN.
7. Checksum of the program portion of the tape.
8. Leader/trailer.



There are 8 channels (or columns) in a papertape.. If the tape is held vertically, with the arrows pointing up, the leftmost channel on the printed side is channel 8; the rightmost is channel 1. The small holes are the sprocket holes. In the examples, 1 signifies a punched hole.

Examples of format:

TAPE CHANNEL	MEANING	NOTES
87 654 S 321 10 000 . 000	leader/trailer	There should be at least an inch where it is required.
11 011 . 000	field setting	Channels 7 and 8 identify a field setting. Channels 4, 5, and 6 contain the number of the field; in this case, 3.
01 000 . 010 00 011 . 100	origin setting	Channel 7 identifies an origin setting. Channels 6, 5, 4, and 3, 2, 1 of both frames indicate the address; in this case, 0234.
00 111 . 110 00 101 . 100	data word	Two frames are necessary for each 12 bit data word. Channels 7 and 8 of each are not punched. In this case, the word is 7654.

SS BIN itself must be in RIM format. This means that origin and data words are alternated for the length of the tape; for example:

01 111 . 110	origin	7600
00 000 . 000		
00 100 . 011	data	4323
00 010 . 011		
01 111 . 110	origin	7601
00 000 . 001		
00 111 . 000	data	7041
00 100 . 001		

The RIM loader places each data word into the location specified by the previous origin.

The object tape must be in binary format. It should begin with an origin setting or with a field setting and an origin setting.



Until a field setting is found, the program will be placed in the same field as SS BIN. The first word of data following the origin will be placed in the location specified by that origin. Successive data words will be placed in sequential locations following that until another origin or more leader/trailer is found. No notice is taken of page boundaries. After location 7777 of a field is loaded, loading continues with location 0 of the same field. The field setting is used to specify into which field the data is to be loaded.

If the object program is to be started by SS BIN, the starting address may be given as an origin setting immediately preceding the checksum. It should be preceded by a field setting. SS BIN will transfer control to the object program at the address indicated with the instruction field and data field equal to the field specified in the latest field setting, or in the field of SS BIN if no field settings were found.

The checksum is a sum of all the frames punched on the tape except the leader/trailer and field settings. For example, the data word 7654 would be added into the checksum as 76+54 or 152 (octal). Any bits carried beyond 12 bits are ignored. The checksum is punched as a data word immediately before the final leader/trailer. As the tape is loaded, SS BIN adds the frames and accumulates its own checksum. When the tape has been loaded, the punched checksum is compared with the one accumulated by the SS BIN. If they are not the same, an error has occurred.

Some assemblers, including PAL III and MACRO-8, will punch error messages into the binary tapes on the Teletype punch if errors occur during assembly. These are preceded and followed by rubouts (ASCII code 377--all 8 channels punched). SS BIN will ignore all data between the rubouts.

#### 6.1 GENERATING TAPES TO BE LOADED WITH SS BIN

The starting address for the object program may be generated with an origin statement as the last statement of the source program. If the source program contains literals, the FIELD pseudo-op should be used to cause the page 0 literals and links to be punched, to punch the field setting, and to supply an origin of 002000. The actual starting address may be supplied after the FIELD pseudo-op.



If OS/8 is being used to produce the binary tapes, the /B option of PIP may be used to combine the binary file of SS BIN and the object program. The resulting combined file may then be punched as one tape.

If the papertape assemblers are used, SS BIN should be copied first, and then the punch turned off. The source program may then be assembled. When the assembler is ready to punch the object program, the punch should be turned on. This will cause the object program to be punched onto the same tape as SS BIN.

The source tape of SS BIN produces a RIM format tape with a checksum. SS BIN will cause the RIM loader to ignore this checksum. SS BIN may, therefore, be assembled with any of the PAL-type PDP-8 assemblers.



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/SELF-STARTING BINARY LOADER

/NOVEMBER 1971

SM

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/ MAYNARD, MASSACHUSETTS 01754



9	6007	CAF=6007			
10	7767	RIMS2=7767			
11	7761	RIMR1=7761			
12	7776	COUNT=7776			
13					
14	7600	*7600	JMS ASSEMB	/PUT CHECKSUM TOGETHER	
15	4332	END,			
16	7601	*	CIA		
17	7041	*	TAD CKSUM	/GET TOTAL	
18	7602	*	SZA	/GOOD LOAD?	
19	1352	*	HLT	/NO--HALT AND DISPLAY DISCREPENCY	
20	7603	*	TAD SWITCH	/WAS LAST DATA AN ORIGIN?	
21	7440	*	SZA CLA		
22	7604	*	JMP .+7	/NO--DO NOT START EXECUTION	
23	7402	*	CAF	/YES--RESTORE MACHINE STATE TO START	
24	7605	*	TAD FLD		
25	1353	*	DCA .+1	/SET INSTRUCTION FIELD TO LAST LOADED FIELD	
26	7606	*	HLT		
27	7640	*	JMP I ORIGIN	**EXIT TO LOADED PROGRAM**	
28	7607	*	HLT	/LOAD O.K. NOT SELF START	
29	5216	*			
30	7610	*			
31	6007	*			
32	7611	*			
33	1252	*			
34	7612	*			
35	7001	*			
36	7613	*			
37	3214	*			
38	7614	*			
39	7402	*			
40	7615	*			
41	5747	*			
42	7616	*			
43	7402	M376,			
44	7617	*			
45	6032	BEGIN,			
46	7620	*			
47	6014	*			
48	7621	*			
49	6214	*			
50	7622	*			
51	1341	*			
52	7623	*			
53	3252	*			
54	7624	*			
55	1342	*			
56	7625	*			
57	3274	*			
58	7626	*			
59	4261	*			
60	7627	*			
61	5226	*			
62	7630	*			
63	1343	*			



64	7631	*	DCA LEAD	/NO LONGER IGNORE BLANK TAPE
65	3274	*		
66	7632	*	DCA CKSUM	
67	07632	LOAD,		
68	7633	*	TAD CHAR	
69	1346	*		
70	7634	*	DCA WORD1	/STORE FIRST HALF
71	3350	*		
72	07634	*	JMS READ	/GET SECOND HALF
73	7635	*	DCA WORD2	/STORE IT
74	07635	*	JMS FETCH	/IS NEXT WORD LEADER/TRAILER?
75	7636	*	JMP END	/YES--THIS IS THE CHECKSUM
76	07636	*	JMS ASSEMB	/NO--PUT WORD TOGETHER
77	3351	*		
78	7637	*	JMS FETCH	/IS IT AN ORIGIN?
79	4261	*	JMP FLD	/NO
80	5200	*	DCA ORIGIN	/YES--RESET ORIGIN
81	7641	*	DCA SWITCH	/RESET ORIGIN SWITCH
82	07641	*	TAD WORD1	
83	4332	*	TAD WORD2	
84	7642	*	TAD CKSUM	/UPDATE CHECKSUM
85	7420	RESTOR, SNL	JMP LOAD	
86	7643	*	HLT	/SHOULD CONTAIN CDF NO
87	5252	*	DCA I ORIGIN	/LOAD DATA
88	7644	*	ISZ SWITCH	
89	3347	*	70	/EFFECTIVE NOP
90	7645	*	ISZ ORIGIN	
91	3353	*	177	
92	7646	SUM,	JMP SUM	
93	1350	*		
94	7647	*		
95	1351	*		
96	7650	*		
97	1352	*		
98	7651	*		
99	5232	*		
100	7652	FLD,		
101	7402	*		
102	7653	*		
103	3747	*		
104	7654	*		
105	2353	*		
106	7655	C70,		
107	0070	*		
108	7656	*		
109	07656	*		
110	07657	C177,		
111	0177	*		
112	7660	*		
	5246			



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/SUBROUTINE TO FETCH A CHARACTER FROM INPUT TAPE
/RETURNS TO CALL+1 IF LEADER/TRAILER
/RETURNS TO CALL+2 IF DATA OR ORIGIN
/HANDLES FIELD SETTINGS AND RUBOUTS

7661 *
07661 00000 *
07662 3332 *
07663 4306 *
07664 1216 *
07665 7740 *
07666 2332 *
07667 1332 *
07670 7010 *
07671 7671 *
07672 7672 *
07673 7673 *
07674 7674 *
07675 7650 *
07676 5661 *
07677 7677 *
07700 7700 *
07701 7701 *
07702 7702 *
07703 7703 *
07704 7704 *
07705 5661 *

DCA ASSEMB /RESET RUBOUT SWITCH
JMS READ /FETCH A CHARACTER
TAD M376
SMA SZA CLA /IS IT A RUBOUT?
ISZ ASSEMB /YES--WAS SWITCH -1?
TAD ASSEMB
RAR /NO--
SZL CLA /IS RUBOUT SWITCH SET?
JMP FETCH+2 /YES--IGNORE CHARACTER
TAD CHAR /CHARACTER IS GOOD DATA
HLT /WILL BE TAD M200 OR AND C177
SNA CLA /IS IT LEADER/TRAILER?
JMP I FETCH /YES--RETURN--
TAD CHAR
TAD M300
SMA /IS IT A FIELD SETTING?
JMP FSET /YES--HANDLE IT
ISZ FETCH /NO--ORIGIN OR DATA
7600 /CLA
JMP I FETCH /--RETURN--

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162 /INPUT ROUTINE
163 /SET BY INITIALIZATION CODE FOR EITHER ASR33 OR HIGH SPEED READER
164 /ENTER WITH AC=0
165 /EXIT WITH CHARACTER IN AC AND IN CHAR
166
167
168
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07706	7706	*.	READ, 0		
07707	7707	*.	DCA COUNT	/PREPARE TO TIME OUT	
07710	7710	*.	IS2 COUNT	/IF OUT OF TAPE	
07711	7711	*.	JMP WAIT		
07712	7712	*.	NOTAPE, KRB	/OR RCC=6016	
07713	7713	*.	KSF	/OR RSF=6011	
07714	7714	*.	JMP .-4		
07715	7715	*.	KRB	/OR RCC=6016	
07716	7716	*.	DCA CHAR		
07717	7717	*.	TAD CHAR		
07720	7720	*.	JMP I READ	/--RETURN--	
07721	7721	*.	TAD M40		
07722	7722	*.	DCA INIT		
07723	7723	*.	IS2 INIT		
07724	7724	*.	JMP .-1		
07725	7725	*.	JMP TAPE		
07726	7726	*.	FSET, AND C70	/MASK OUT ALL BUT FIELD NUMBER	
07727	7727	*.	TAD CDF0	/GET REST OF CDF	
07730	7730	*.	DCA FLD	/INSERT WHERE IT WILL BE EXECUTED	
07731	7731	*.	JMP FETCH+2		

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/HANDLER FOR FIELD SETTING
/ENTERED FROM FETCH

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/SUBROUTINE TO ASSEMBLE TWO CHARACTERS INTO ONE WORD FOR STORAGE
/ENTER WITH AC=0
/EXIT WITH WORD IN AC

7732 * ASSEMB, 0
0000
07732
7733 *
1350
07733 TAD WORD1
7734 *
7106
07734 CLL RTL
7735 *
7006
07735 RTL
7736 *
7006
07736 RTL
7737 *
1351
07737 TAD WORD2
7740 *
5732 JMP I ASSEMB /---RETURN---
/CONSTANTS
7741 *
6201 CDF 0
07741
7742 *
0257 MASK, AND C177
07742
7743 *
1304 LT, TAD M200
07743

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/INITIALIZATION CODE  
/USED ONCE ONLY--MAY BE OVERWRITTEN BY DATA BREAKS

/TEMPORARY STORAGE LOCATIONS  
/MAY ALSO BE OVERWRITTEN BY DATA BREAKS

07744	7744	*.	INIT,	CLA
	7200	*.		
	7745	*.		
07745	1361		TAD	RIMR1
	7746	*.		
07746	3312		CHAR,	OCA NOTAPE
	7747	*.		
07747	1367		ORIGIN,	TAD RIMS2
	7750	*.		
07750	3313		WORD1,	OCA TAPE
	7751	*.		
07751	1361		WORD2,	TAD RIMR1
	7752	*.		
07752	3315		CKSUM,	OCA TAPE+2
	7753	*.		
07753	1242		SWITCH,	TAD RESTOR
	7754	*.		
07754	3372		OCA	7772
	7755	*.		
07755	5217		JMP	BEGIN

/STARTING ADDRESS FOR MANUAL START

	7777	*7777	
07777	5217		JMP BEGIN

/LOCATION TO OVERLAY RIM AND START LOADER

	7772	*7772	
07772	5344		JMP INIT

\$



ASSEMB 7732  
BEGIN 7617  
CAF 6007  
COF0 7741  
CHAR 7746  
CKSUM 7752  
COUNT 7776  
C177 7657  
C70 7655  
END 7600  
FETCH 7661  
FLD 7652  
FSET 7726  
INIT 7744  
LEAD 7674  
LOAD 7632  
LT 7743  
MASK 7742  
M200 7704  
M300 7701  
M376 7616  
M40 7665  
NOTAPE 7712  
ORIGIN 7747  
READ 7706  
RESTOR 7642  
RIMR1 7761  
RIMS2 7767  
SUM 7646  
SWITCH 7753  
TAPE 7713  
WAIT 7721  
WORD1 7750  
WORD2 7751  
279



ASSEMB	15	82	123	131	133	219#	231
BEGIN	45#	267	272				
CAF	9#	31					
CDF0	51	207	234#				
CHAR	70	141	149	185	187	253#	
CKSUM	19	68	96	261#			
COUNT	12#	171	173				
C177	110#	236					
C70	106#	205					
END	15#	80					
FE1CH	59	78	121#	139	147	157	161
FLD	33	53	86	100#	209		211
FSET	155	205#					
INIT	193	195	249#	276			
LEAD	57	66	143#				
LOAD	68#	98					
LT	63	238#					
MASK	55	236#					
M200	159#	238					
M300	151	153#					
M376	43#	127					
M40	129#	191					
NOTAPE	177#	253					
ORIGIN	41	88	102	108	255#		
READ	74	125	169#	189			
RESTOR	84#	263					
RIMR1	11#	251	259				
RIMS2	10#	255					
SUM	92#	112					
SWITCH	25	90	104	263#			
TAPE	179#	199	257	261			
WAIT	175	191#					
WORD1	72	92	221	257#			
WORD2	76	94	229	259#			